I-76 interchange looking north.

PENNSYLVANIA Pennsylvania Sets The Standard For Urban Projects

TRIMMING TIME AND CUSTOMER INCONVENIENCE ON MAJOR INTERSTATE RECONSTRUCTION PROJECT

US Route 202 in Pennsylvania is a 59 mile-long highway that connects New Jersey to the north with Delaware to the south. It serves as a major commuter route and vital link for business and industry in the tri-state region. The highway varies in size from a two-lane road to a six-lane expressway, with traffic volumes ranging from 17,000 to 180,000 vehicles a day. Along the way, the 40-year old artery serves a booming commercial corridor just outside Philadelphia, helping to generate billions of dollars for the local and national economy.

Pennsylvania's challenge was to update the highway at critical interchanges within this corridor while minimizing construction delay and inconvenience to customers. The Pennsylvania Department of Transportation's response – including creative design, innovative construction techniques, the use of A+B bidding, contractor incentives and disincentives and innovative pavement techniques – reflects the new breed of thinking, planning, innovation, and problem-solving recognized by the Federal Highway Administration's (FHWA) Highways for LIFE (HFL) program.

US Route 202 and its interchanges with US Route 422 and I-76 (Schuylkill Expressway) were constructed 40 years ago when vehicle speeds and traffic volumes were much lower. By 2001, more traffic converged at these interchanges than anywhere else in the State. Commercial development had saturated the area and, as a result, the adjacent US 202/Gulph Road intersection handled approximately 60,000 vehicles daily. Along with high traffic volumes came congestion and safety issues as motorists struggled to traverse the aging and sub-standard facilities – a true threat to the region's economic prosperity.

In April of 2001, the Pennsylvania Department of Transportation (PennDOT) and its contractor, Allan A. Myers, Inc., began a complete reconstruction and reconfiguration of the interchanges with US 202/US 422 and US 202/I-76 – a $104 million project that represented just one piece of Pennsylvania's four-part, $290 million US 202 Improvement Project. The interchange project was so complex that the construction package included 2,000 plan sheets detailing designs for the interchanges as well as 25 structures, three-and-one-half miles

of limited access highway, one mile of urban arterial roadway, five traffic signals, and three traffic signal interconnect systems. In addition, the package called for $14 million in Intelligent Transportation System enhancements along with improvements in erosion control, lighting, traffic control, signage and pavement markings.

Designing for Congestion Relief and Safety

Rex Mackey, a Senior Assistant Construction Engineer with PennDOT at the time, knew that congestion relief was only one goal of the finished project. Another critical element was to improve safety by eliminating dangerous weave moves required of motorists navigating the area. The solution: split traffic and use fly-over bridges to carry drivers to their desired routes, reducing the need to merge and move laterally across crowded lanes.

As part of the safety solution, the project featured a new direct connection ramp from US 202/US 422 to I-76. The inclusion of such a ramp may not break new ground, but PennDOT located this structure one entire interchange ahead of destination – a departure from standard practice. The long approach was necessary to accommodate overpasses that carried vehicles above and across through lanes in order to eliminate the weave.

PennDOT's response to such congestion and related safety issues was only the beginning of creative problem-solving demanded by the complex project. Looming on the road ahead were many challenges, including a 540-ton piece of Pennsylvania history, cleverly transformed from obstacle to opportunity by the PennDOT team.

Context Sensitive Design Delivers Enhancements

Just 300 feet south of the Gulph Road intersection, the historic King of Prussia Inn sat abandoned and deteriorating – right in the middle of a US 202 median. The 290 year-old building is listed on the National Register of Historic Places and was reportedly frequented by George Washington during the winter encampment at Valley Forge. PennDOT was challenged by stakeholders to preserve the structure, if at all possible. One major problem: the Inn had been constructed prior to the use of cement mortar in "the colonies," making it inherently unstable. The project team conducted a closely scrutinized engineering evaluation that concluded the Inn could be stabilized and relocated.

Assembling the steel members for the span 2 truss for a new railroad bridge over I-76.

PennDOT's innovative approach to solving the traditional "historic preservation versus highway improvement" dilemma paved the way for subsequent improvements to the US 202/Gulph Road intersection. Capitalizing on the wide median area that would no longer be occupied by the Inn, the project team created a design that compressed the intersection to fit within existing right-of-way limits, accommodating safety and traffic capacity improvements that significantly benefited customers.

Eventually, the structure was moved half a mile away, assisted on its journey by 21 hydraulic dollies. The Inn was restored by the local King of Prussia Chamber of Commerce to house its offices as well as other operations, a library and a museum – providing a new asset to the community and its visitors.

PennDOT's historic win-win solution helped the project reach across time to generate improvements, not just to the roadway, but to the character of the region it served. The team met the challenge of time once again as it considered innovative contracting methods to reduce the length of the construction schedule.

Time is Money to Contractor

As in many urban areas, high traffic demand in the busy corridor necessitated that project construction be completed as quickly as possible. And as in other urban areas, high traffic volume presented significant challenges to that goal. To maximize the contractor's latitude and creativity in accelerating construction, PennDOT employed the increasingly popular contracting tool of "A+B" bidding. This method allows the owner agency to award a project based on factors of both cost and time. Each bid submitted consists of two parts:

- The "A" portion is the sum a company bids for contract work items.
- The "B" portion is the time in calendar days proposed to complete the project, multiplied by a daily cost determined by the State.

The construction contract included a clause that provided a $30,000 a day incentive if construction was completed ahead of schedule, along with a similar disincentive for late completion. According to Mackey, the actual user cost for any delay was determined to be $78,000 a day. Since the user cost was so high, however, PennDOT elected to cap the per day incentive/disincentive at a significantly lower rate.

Allan A. Myers, Inc. won the work by submitting the lowest bid. The incentive/disincentive clauses kept Myers moving quickly to meet tight deadlines and also prompted a great deal of shift work. In the end, the contractor earned nearly $1 million in total incentive payments and incurred only one disincentive charge of $270,000, when a single phase of the project was finished nine days beyond its scheduled completion date.

PennDOT's use of A+B bidding helped the agency reduce customer inconvenience by maintaining an optimized schedule. But it did not prohibit the delivery of other important benefits, including improved construction quality and maintenance of a high level of service – despite one more significant challenge: the need for seven days a week daytime and evening access to a cornerstone of the local economy.

Maintaining the Flow of Commerce and Construction

Along the reconstruction zone, at the already challenging US 202/Gulph Road interchange, lies the largest shopping mall on the east coast, the expansive King of Prussia Mall, which generates $1.5 billion in business annually. Carmine Fiscina, of FHWA's Philadelphia, PA office, said that accommodating the needs of the Mall and its users considerably heightened demands on the project. The high volume of vehicles flowing through the construction area to and from the mall on a daily basis necessitated careful coordination of construction phases. PennDOT's response was a Maintenance and Protection of Traffic Plan that proved critical to project success.

Key actions included:

- construction of the US 202 to eastbound I-76 ramp prior to major construction on US 202
- additional regional train/bus service
- construction of three new park-and-ride lots
- improvements along projected alternative routes.

In addition, to minimize impacts to the King of Prussia Mall during the holiday season, the contractor was required to ease traffic-restrictive work between November 1 and March 15. This did not create delays for the larger project, however, since work in the vicinity was shifted to bridge construction as well as retaining and noise abatement walls, which did not impede the flow of traffic.

According to Fiscina, this series of efforts to stay on schedule while minimizing traffic disruption within an economic artery contributed substantially to the success of the overall project. As work rolled on, the PennDOT team became ever more adept at overcoming obstacles throughout the corridor. In a few cases, however, the teams' best solutions proved to be a bit more dramatic – even explosive.

Excavating and installing drainage pipe for the roadway of SB 202 west of Gulph Road.

Innovative Construction Techniques Elevate Safety, Save Time and Customer Headaches

PennDOT deftly relocated an historic inn and steered clear of shoppers during a busy holiday season, but when workers began excavation for a footing that was part of a ramp over I-76, they encountered an obstacle for which brute force was the likely solution: limestone.

Traditional methods called for the use of a hydraulic breaker to demolish the rock and a drilling contractor to bore vertical holes 10 feet deep, in order to provide lateral resistance sufficient to insert the bridge pile. A total of 30 working days, plus two weeks of preparation in which to sign contracts and mobilize a contractor, would be required – a heavy toll for the construction schedule, particularly in response to an unforeseen obstacle. Plus, since the critical path of the project went through this area, every day that ramp construction was delayed, the project was delayed. Contract provisions created yet another obstacle: such a delay would push into the middle of January progress on a portion of the bridge tie-in paving – not a good time of year for concrete work in the cold Northeast.

Instead, PennDOT chose the use of explosives to remove the limestone, cutting the time consumed by this unanticipated phase of the job from an estimated 63 days to only five. The change order, under which a contractor drilled, blasted the rock and then back-filled the footing, cost the Department $30,000 and delivered a reduction of over 90% in the number of days that would have been required to overcome the obstacle by traditional means. It is difficult to calculate the true cost of time, labor and delay PennDOT avoided, particularly in terms of the overall impact on the project. But in the end, even the five days lost to demolition were recovered, because the contractor was directed to work overtime to make up any lost hours on the schedule.

While explosives made short work of onsite removal of one obstacle, PennDOT chose an exercise in heavy lifting to safely eliminate another.

Bridge Demolition Gets a Lift

A railroad through girder bridge that passed over traffic on I-76 was slated for removal during the reconstruction process. Demolishing the structure in place meant repeated traffic stoppages at a minimum of 15 minutes each, after which drivers would lose additional travel time as the contractor worked to clear the back-up. During the tiny window that traffic was stopped, the contractor would need to move quickly to put an excavator-mounted hydraulic breaker in place, then destroy and remove bridge components.

Mackey notes, “As you can imagine, this would have been very inefficient and resulted in poor productivity for the contractor, large costs for Maintenance and Protection of Traffic, significant delays to motorists – and it’s also dangerous.”

Thinking outside the box, the contractor deployed a specialty subcontractor, Mammoet, who used a Pressure Vessel Transporter to hydraulically lift the existing girder off its bearings, after which the Transporter drove it to the side of the road where demolition could be completed without working over traffic. Doing so during daylight hours, away from the expressway, resulted in a total project time savings of 20 days. The investment in Mammoet’s services also saved drivers from multiple, significant delays, while minimizing danger for all concerned.

Once the bridge superstructure was safety relocated and demolished, the massive original railroad abutments had to be removed. PennDOT's original plan called for a hydraulic breaker, operating from 11:00 p.m. to 5:00 a.m. for approximately three weeks, to destroy the hefty structures. Just one night of hydraulic pounding loosed more than PennDOT bargained for: a cascade of phone calls to the Department's District Office and a local State Senator from angry residents complaining about the noise. Shifting gears, the agency hired a blasting contractor, Controlled Demolition, Inc., who accomplished in one tenth of a second what would have required 126 hours of all-night breaking.

At a cost of $100,000, PennDOT paid a premium for its decision, but made a sound investment in customer satisfaction by eliminating weeks of sleepless "school nights." The agency donned its "thinking cap" once again to boost pavement performance, and in the process helped to secure its legacy of customer service well into the future.

Investing in Longer Life

Even as PennDOT met the myriad challenges presented by major reconstruction under traffic in a crowded corridor, one final obstacle remained. Heavy traffic volumes and a large percentage of truck travel in the area produced loads requiring a relatively high pavement structural rating. But soils in the project locale were poorly drained and underlain by limestone, producing problems in terms of ensuring pavement structural integrity.

On reconstruction projects, the tendency is to minimize pavement thickness in order to lessen the excavation required to reach sub-grade elevation. However, to combat the challenging soil conditions, the project team used a thicker than normal sub-base pavement section (eight inches vs. the usual four). This placed the bottom of the paving section below the frost line (estimated at 30 inches) to minimize the destruction caused by recurring frost heave cycles.

One further measure of stability involved the use of geotextile fabric placed between the sub-grade and sub-base material to enhance drainage.

PennDOT expects to recoup many times over the incremental costs of these decisions, since the final result is significantly lengthened pavement service life. Less maintenance means better service to customers over the lifetime of the roadway.

Partnering Efforts Educate Customers and Alleviate Concerns

By its nature and location, this high profile, urban transportation project carried the potential to impact – positively or negatively – some 200,000 motorists, passengers and residents every day, both during construction and in the decades of travel to come. The project team, together with PennDOT's press office, area transportation management associations and local municipalities, made it their business to engage customers right from the start, which provided all stakeholders with an understanding of the design and construction process and a chance to express their own concerns and needs as plans progressed.

An extensive public relations program included brochures, newsletters, a website and radio spots, as well as many public and one-on-one meetings. Engineers from the State, along with the construction manager, met with one community advocacy group on a bi-weekly basis. The outreach program educated the public and business community about existing problems and proposed solutions, while keeping them informed of schedules, costs and potential traffic impacts.

Meetings held during the design process informed customers of the project status and proposed improvements, and provided a forum in which to raise questions and mitigate issues. One area of high public interest and involvement was the final design of noise barriers. Individual townships and developments met with project personnel to determine the finish and color of abatement panels, resulting in an aesthetically-pleasing product that will long reflect the input of the community.

The Greater Valley Forge Transportation Management Association (GVFTMA) maintained the project's website (www.us202.com) and distributed a newsletter that provided information regarding project status and schedules. The group also produced several videos for local companies and municipalities, and sponsored radio spots that helped to earn customer appreciation and support as they became valuable sources of information about plans for maintaining traffic throughout construction.

Federal money, administered by the local Chester Transportation Management Association and GVFTMA, was made available to address congestion mitigation strategies. The funding was used to provide corporate bus service that allowed companies to shuttle their employees to and from commuter lots. Additional train service and park-and-ride lots also helped reduce traffic volumes in the corridor as work continued.

The two associations proved pivotal in promoting the project's congestion mitigation strategies. During the construction phase, GVFTMA sponsored no less than 186 events to inform businesses and communities about project details and to promote alternative modes of travel. It also maintained a mailing list of over 1,000 individuals and distributed more than 75,000 brochures about the project.

Working together with community stakeholders and highway users, PennDOT not only delivered a successful project, it helped build relationships and practices sure to serve the agency for years to come.

Constructing a new box culvert under the roadway of SB 202 at Gulph Road.

A Model for Future Projects

The US 202 Reconstruction Project set out to eliminate dangerous traffic weaving patterns and to transform an outdated roadway into a true asset for one of Pennsylvania's most vigorous economic corridors. Along the way, the project produced new, residual assets – a visitor center and public facility that arose from an abandoned historic inn once standing in the way of improved mobility, and relationships with stakeholders that increased the community's sense of investment in the successful outcome. All stand as a testament to the broader benefits that emerge from a focus on innovation and optimal quality.

Technical, structural, economic, and geological challenges were met with a host of tools that can be applied to project delivery nationwide: selective use of high cost, high impact technologies to improve safety and reduce construction time, careful phasing, measures to improve pavement performance and reduce future maintenance costs, innovative contracting, highly effective, multi-media public information dissemination, among others.

Pennsylvania's true savings in time and money can only be derived through a complex equation weighing the costs of construction, congestion, delay, and impacts to commerce and to human safety against an outcome that releases an unfettered, significantly safer pipeline of economic and personal mobility. But one thing is clear: a commitment to accelerated construction, stakeholder involvement, durable performance and innovative use of technology and resources is the new standard by which our nation will enhance its infrastructure – the foundation on which roadway leaders have begun to deliver Highways for LIFE.

New concrete pavement and new ramps at Chesterbrook Blvd.